

THE CESTODE *TAENIA KREPKOGORSKI* (SCHULZ & LANDA, 1934) IN THE ARABIAN SAND-CAT (*FELIS MARGARITA* LOCHE, 1858) IN BAHRAIN

By R. A. BRAY

CONTENTS

	<i>Page</i>
SYNOPSIS	183
INTRODUCTION	183
DESCRIPTION	184
DISCUSSION	187
RELATIONSHIPS	188
ACKNOWLEDGMENTS	192
REFERENCES	193

SYNOPSIS

Taenia krepkogorski is redescribed from the Arabian sand-cat (*Felis margarita*) in Bahrain and its relationship to other species of *Taenia* is discussed.

INTRODUCTION

A NUMBER of parasitic worms from the intestine of an Arabian sand-cat (*Felis margarita*) obtained in Bahrain were presented to the British Museum (Natural History) by Major M. D. Gallagher. The following species were present in the collection.

Cestoda:

Diplopylidium noelleri (Skrjabin, 1924)

Taenia krepkogorski (Schulz & Landa, 1934)

Nematoda:

Ancylostoma braziliense de Faria, 1910*

Rictularia affinis Jägerskiöld, 1904*

Acanthocephala:

Echinopardalis atrata Meyer, 1931*

This appears to be the first record of *A. braziliense* and *E. atrata* in this host.

The cestode *Taenia krepkogorski* is little known, and doubts have been expressed as to its validity as a distinct species (Verster, 1969). Originally, this worm was

*Thanks are due to Miss Eileen A. Mitchell who identified these worms.

reported as a strobilocercus larva in *Gerbillus meridianus* from the Northern Caucasus and in *Rhombomys opimus* from Kazakhstan (Schulz & Landa, 1934). The adult worm appears to have been described only by Petrov & Potekhina (1951, 1953) from *Felis ornata caudata* [= *Felis libyca caudata*] in Tadzhikistan. With these facts in mind, it has been thought that a further description of this species, based on material other than that already described, would be useful.

DESCRIPTION

Taenia krepkogorski (Schulz & Landa, 1934) Verster, 1969

Hydatigera krepkogorski Schulz & Landa, 1934.

Fifteen worms were found in the intestine of the sand-cat, and of these six were stained with Mayer's paracarmine and prepared as whole mounts. Series of transverse and horizontal sections stained with Ehrlich's haematoxylin and counter stained with erythrosin were also prepared.

The worms measure from 12 to 31 mm in length and up to 3 mm in maximum width, which generally occurs in the region of the later mature segments. The longest strobila consists of 99 segments. In all the specimens the mature segments are about seven times as broad as long (e.g., 2.7 mm \times 0.4 mm), while the early gravid segments are about four times as wide as long (e.g., 2.5 mm \times 0.66 mm). Later gravid segments tend towards a squarish outline, and the last three segments in the longest specimen are longer than wide.

The scolex has a width of between 0.56 mm and 0.84 mm, while the everted rostellum is 0.40–0.56 mm in diameter. The rostellum bears a double crown of hooks, of which there are between 68 and 76. The hooks were measured in preparations where the scolex had been placed *en face* on a slide in Berlese fluid, and pressure applied to spread the hooks conveniently for measuring (see Bursey & Burt, 1970). The arrangement of hooks was examined on a scolex mounted *en face*, but not squashed, and also on scanning electron micrographs. As is usual in the genus *Taenia* the hooks are of two sizes, arranged alternately in two crowns the larger hooks forming the anterior circle. When examined *en face* on a light microscope the arrangement of the hooks appeared typically in two circles (Plate 1a), while the stereoscan pictures show the larger hooks disposed in two alternating circles, thus giving the rostellum the appearance of carrying three distinct crowns of hooks (Plate 1b and c). The larger hooks measure from 300–330 μ m in length and the smaller hooks 200–222 μ m (fig. 1). The suckers are either rounded (about 230 μ m dia.) or, more often, oval (232–280 μ m \times 125–212 μ m).

The segments which occur close behind the scolex are wider than the scolex, and they increase in size to almost the maximum width of the body at about the twentieth segment. Some of the shorter strobila show a distinct neck measuring up to 0.6 mm, while the remainder of specimens, presumably due to contraction, show signs of segmentation immediately behind the scolex.

In transverse section the longitudinal musculature can be seen to form two distinct concentric layers of bundles. Those in the outer layer are usually about half the

size of those in the inner. Complete bundles in the inner layer contain about 38–42 fibres, while those in the outer layer have about 19–30 fibres which appear to be rather more closely packed. The bundles in both layers are weakly developed and very numerous. A single layer of circular muscle-fibres lies inside the longitudinal layers (fig. 2b).

The ventral excretory vessels are much larger than the dorsal and are more laterally disposed. In cross-section the lumen of the ventral canal is about 0.15 mm in diameter, and that of the dorsal canal about 0.01 mm. The two ventral vessels are connected by a transverse canal lying near the posterior margin of the segment. No corresponding connection between the dorsal vessels has been made out either in whole preparations or in serial sections. The longitudinal nerve-cords lie close to the ventral canals and directly lateral to them.

The genital pores alternate irregularly, and are situated at about the middle level of the segment margin. The genital ducts pass ventrally to the excretory canals and open into the base of a genital atrium, which is narrow and 0.2–0.25 mm deep.

The cirrus-sac, as seen in transverse and horizontal sections, is more or less club shaped, usually reaching to the ventral excretory vessel and measuring 310–430 μ m by 70–90 μ m. It contains an uncoiled tubular cirrus. An everted cirrus was not seen. A tightly coiled vas deferens leads into the cirrus-sac. The maximum number of testes counted in a single horizontal section was about 145, while an estimate of their number from an examination of whole mounts varies between 360 and 400. Each testis is globular, or nearly so, and measures 25–35 μ m in diameter. They are arranged in two lateral groups of roughly equal size, joined by a narrow band of testes disposed anteriorly to the ovary. The lateral fields do not meet behind the vitelline gland (fig. 2a).

The ovary is distinctly bilobed, each lobe consisting of a number of follicles arranged fan-wise. Posteriorly to the ovary lies the vitelline gland, which is transversely elongate and measures about 0.5 mm across. A conspicuous shell-

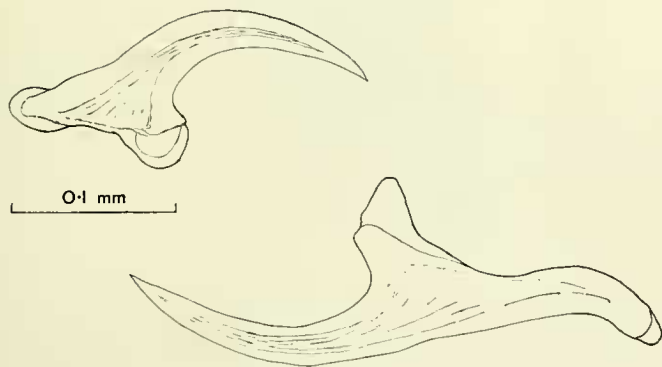


FIG. 1. *Taenia krepkogorski*: hooks.

gland lies in the median line between the ovarian lobes. From the shell-gland the vagina runs anteriorly to the poral lobe of the ovary and opens into the genital atrium posteriorly to the cirrus-sac. The vagina, especially at the distal end is strongly muscular, but it appears that there is no differentiated portion which might be described as a distinct sphincter.

The uterus has four or five main branches on each side of the median longitudinal stem, and these divide again into up to six secondary branches (fig. 3). Only one

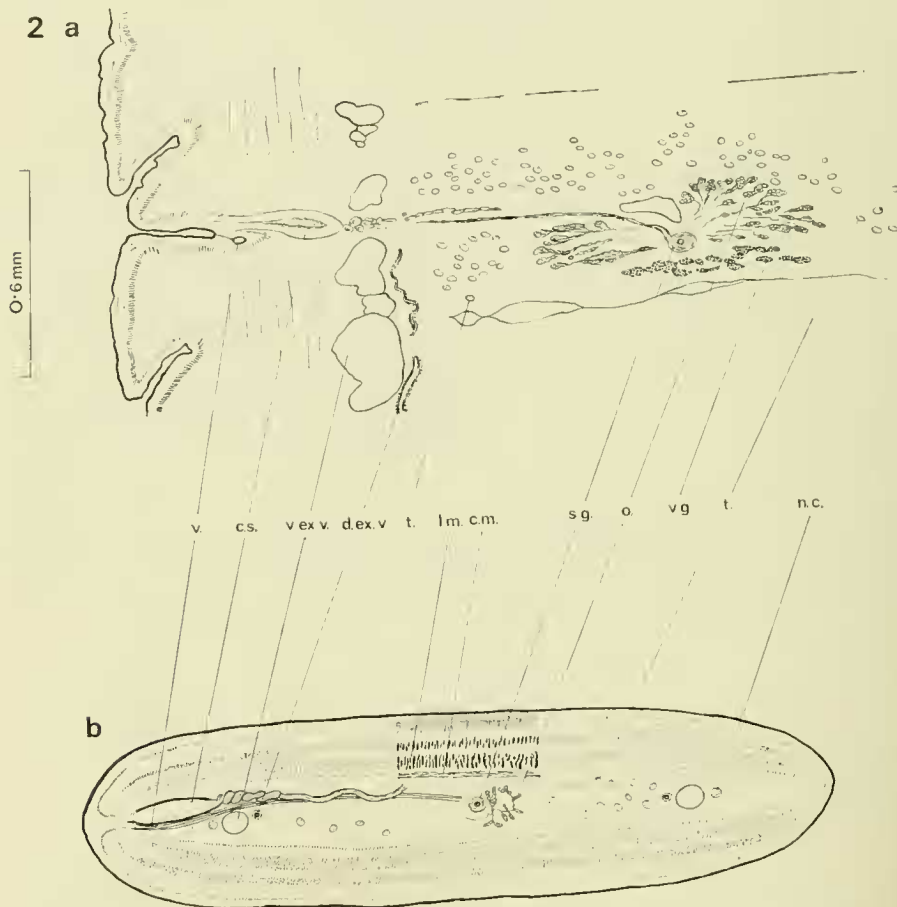


FIG. 2. *Taenia krepkogorski*: a, horizontal section of mature segment (aporal extremity omitted). b, transverse section of mature segment (diagrammatic—small section of musculature shown in detail). Abbreviations: c.m.—circular muscles; c.s.—cirrus sac; d.ex.v.—dorsal excretory vessel; l.m.—longitudinal muscles; n.c.—nerve cord; o.—ovary; s.g.—shell-gland; t.—testis; v.—vagina; v.ex.v.—ventral excretory vessel; v.g.—vitelline gland.

specimen contained fully-developed eggs, these were to be found in the last four segments of the longest specimen. The eggs, measured *in utero*, are $30\text{--}33\text{ }\mu\text{m} \times 23\text{--}25\text{ }\mu\text{m}$. The egg-shell is thick, about $4\text{ }\mu\text{m}$, and the oncosphere about $15\text{ }\mu\text{m}$ in diameter. The embryonic hooks were not seen, presumably they had not yet developed.

DISCUSSION

The material examined appears to be closely related to the adult worms described by Petrov & Potekhina (1951) as *Hydatigera krepkogorski*. In number, size and shape the hooks correspond closely to those described by these authors and also to those originally described by Schulz & Landa (1934) in the larva. The one feature of the hooks not corresponding exactly is the size of the smaller hooks which, in the present material, are very slightly larger on average.

While the length of the worms is rather less than that previously described, the number of segments present is similar. Most of the segments, being much wider

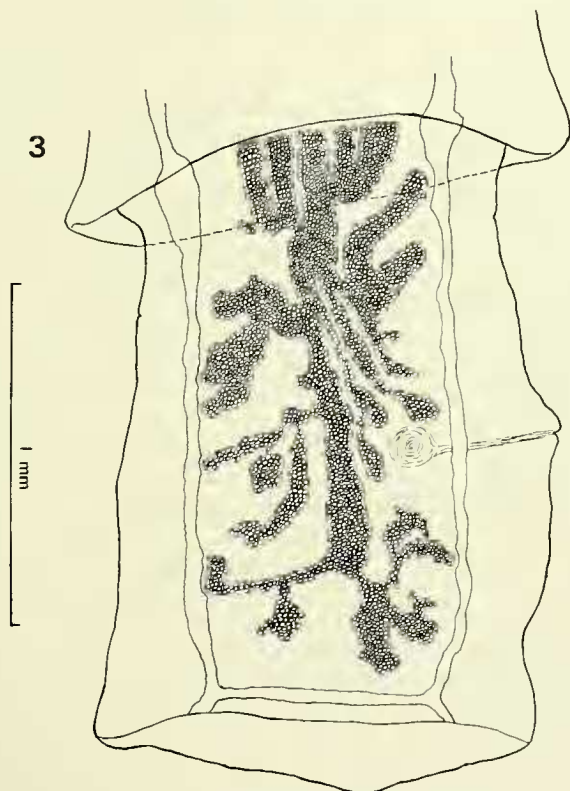


FIG. 3. *Taenia krepkogorski*: gravid segment.

than long, suggest that the worms are contracted, either owing to the method of fixation used or to conditions prevailing in the host.

Other slight differences between these specimens and those previously described, are the smaller size of the scolex and suckers and the fewer lateral branches of the uterus. These minor differences seem to lie within the range of variation usually shown by a species of the genus *Taenia*.

The similarity in the hooks, the general morphology of the segments and the egg-size would appear to place these specimens readily into the concept of the species *Taenia krepkogorski*.

RELATIONSHIPS

Verster (1969) in a revision of the species of the genus *Taenia* designates *T. krepkogorski* as a species of uncertain status and postulates its possible identity with either *Taenia taeniaeformis* (Batsch, 1786), *T. macrocystis* (Diesing, 1850) or *T. endothoracica* (Kirschenblatt, 1948).

Taenia taeniaeformis is a common parasite of felines and is widespread in its distribution. Undoubtedly it is closely related to *T. krepkogorski*, but differs in having fewer hooks of larger size. A number of specimens determined as *T. taeniaeformis* in the collections of the British Museum (Natural History) have been examined, and they agree closely in number of hooks with the numbers found by Verster (i.e., 34–36). Nevertheless, one specimen with 40 hooks was encountered. *T. taeniaeformis* has large hooks 370–402 μm long, and small hooks 210–261 μm long (Verster, 1969) and in both cases these measurements exceed those of *T. krepkogorski*. The latter species lacks a vaginal sphincter, a feature which Verster considers characteristic of *T. taeniaeformis* and which has been seen in the specimens of *T. taeniaeformis* examined for this study. Both species possess a strobilocercus-type larva, but Schulz and Landa mention that in *T. krepkogorski* the larva is found encysted in the mesenteries and that several larvae may occur in each cyst, a condition not normally associated with the strobilocercus of *T. taeniaeformis* which usually occurs singly in the liver of its host.

Of the species of *Taenia* with over 60 hooks, and, as far as it is known, no vaginal sphincter, only *T. laticollis* Rudolphi, 1819, *T. macrocystis* and *T. endothoracica* have hooks of a size and shape similar to those of *T. krepkogorski*. According to Verster *T. laticollis* has 58–62 hooks, with the larger being 307–407 μm and the smaller 183–247 μm in length. The genital ducts of this species pass between the excretory canals. These features readily separate this species from *T. krepkogorski*.

Verster states that Petrov & Potekhina's (1951) description of *T. krepkogorski* appears to be identical with *T. macrocystis*, and her study of the latter species is based solely on material from South and North America. *T. krepkogorski* differs from this American form in the average number of hooks, the overall spread being from 54–74, according to various authors (see Table 1). In *T. macrocystis* the genital ducts pass between the excretory canals, as in *T. laticollis*, and this is therefore another differentiating feature. *T. macrocystis* has also been recorded a number of times from Russia. Gubanov (1956) has described the adult form from an experi-

mental infection of a wolf cub, the larval material having been found in a mountain hare in the Yakutsk Republic. The hook number in the adult is given as 56, and in the larva from 56-60. No indication is made of the course of the genital ducts in relation to the excretory canals. Davlatov (1967) in his description of a larval *T. macrocystis* from a gerbil states that there are 60 hooks present and in both descriptions the size of the larger hooks exceeds those reported for *T. krepkogorski*. Thus on hook number and size alone a difference between *T. krepkogorski* and *T. macrocystis* from Russia can be detected. As will be mentioned later, it seems conceivable that the Russian specimens determined as *T. macrocystis* may not be conspecific with the American form.

TABLE I

Number and length of hooks in *T. krepkogorski*, *T. macrocystis* and *T. endotheracica*

Taenia krepkogorski (Schulz & Landa, 1934)

Author	Number of hooks	Length of large hooks in μm	Length of small hooks in μm	Host and locality
Schulz & Landa, 1934	66-74*	265-315	182-200	gerbils, Caucasus and Kazakhstan.
Petrov & Potekhina, 1951	64-76	312-345	188-204	<i>Felis libyca caudata</i> , Tadjikistan.
Sadikhov, 1954	60-64	354.6	218.4	<i>Vulpes vulpes</i> , Azerbaijan.
Sadikhov, 1962b	60-74	354	188-204	<i>Felis</i> spp., <i>V. vulpes</i> , Azerbaijan.
Present material	68-76	300-330	200-222	<i>Felis margarita</i> , Bahrain.

Taenia macrocystis (Diesing, 1850)

Lühe, 1910	60+	320-340	180	<i>Felis</i> spp., S. America.
Hall, 1919	60-74	320-365	180-200	<i>Lynx</i> spp., U.S.A.
Riser, 1956	—	320-340	190	lynx, Wyoming.
Little & Hopkins, 1969	—	330-340	190	<i>Lynx rufus</i> , Texas.
Verster, 1969	58-60	297-370	183-223	<i>Sylvilagus brasiliensis</i> , <i>Felis wiedii</i> , S. America.
Bursey & Burt, 1970	54-70	336-430	198-247	<i>Lynx</i> spp., <i>Lepus americanus</i> , Canada.
Gubanov, 1956	56-60	336-384	183-216	mountain hares, Yakutsk Rep., wolf-cub, exp.
Davlatov, 1967	60	352-360	192-208	great gerbil, Uzbekistan.

Taenia endotheracica (Kirschenblatt, 1948)

Kirschenblatt, 1948**	52-56	314-332	203-218	<i>Meriones erythraurus</i> , Georgia, U.S.S.R.
Dubnitski, 1952	52-60	351-372	224-241	<i>V. vulpes</i> , Kazakhstan.
Dollfus, 1956	52-64	300-378	201-241	<i>Meriones blackleri</i> , Iran.
Gvozdev & Agapova, 1963	56-64	350-370	210-220	<i>Rhombomys opimus</i> , U.S.S.R., <i>Vulpes</i> spp. and dog, exp.
Dollfus, 1965	56-62	335-360	205-219	<i>Meriones</i> spp., Iran.
Verster, 1969	54	329-338	209-218	<i>M. blackleri</i> , Iran.

*Schulz & Landa (1934) give the number of hooks as 66-72 in the text, but show 74 in their figure

**according to Verster (1969).

Lühe (1910) was the first to draw attention to the unusual arrangement of the larger hooks in *T. macrocystis*, in that they appear to be arranged in two distinct alternating rows. The specific importance of this feature has been stressed by Hall (1919), Riser (1956), Verster (1969) and Bursey & Burt (1970). The figure given by Petrov & Potekhina (1951) of the arrangement of the hooks does not indicate a similar condition in *T. krepkogorski* and neither does the *en face* view of the present material viewed by light microscope (Plate 1a). The stereoscan pictures of the latter material of *T. krepkogorski* (Plate 1b & c), however, shows this unusual arrangement very clearly. It would seem, therefore, that this feature may not be a reliable one for identification purposes, as its appearance varies with the method of examination.

Taenia endothoracica has between 52 and 64 hooks and therefore has fewer than *T. krepkogorski*, the larger hooks being between 300 μ m and 372 μ m in length, with a higher upper limit of size than those so far recorded for *T. krepkogorski*. It appears that the course of the genital ducts in *T. endothoracica* has yet to be described, and Verster places this species in her Group 1 (genital ducts passing between excretory vessels), explaining in a footnote that it is done for convenience only.

As the course of the genital ducts of *T. endothoracica* and the Russian specimens of *T. macrocystis* is not known, certain biological features of these two species and *T. krepkogorski* are compared.

As stated above, *T. krepkogorski* was first recorded as a strobilocercus larva from the mesenteries of the abdominal cavity of *Rhombomys opimus* in Kazakhstan and of *Gerbillus meridianus* from the Northern Caucasus. The larval form has since been found in *R. opimus* in Uzbekistan and Tadzhikistan (Golodnoi Steppe) and in *Meriones erythrourus* in Uzbekistan (Buliginskaya, Vladimirov & Markov, 1956 & 1959; Shleikher & Samsonova, 1953 and Sultanov, Muminov & Adysheva, 1962). The adult has been recorded in various felines. Sadikhov (1962a), has found this cestode in *Felis chaus* and *F. silvestris* in Azerbaijan, and, as already mentioned, Petrov & Potekhina have described it from *F. libyca caudata* in Tadzhikistan. More recently Agapova & Sapozhenkov (1961) have recovered *T. krepkogorski* in *F. libyca ocreata* and *F. margarita* in Turkmeniya. Sapozhenkov (1961) found this worm in *F. margarita* in East Turkmeniya along with *Taenia taeniaeformis* and other helminths, whilst carrying out an ecological survey on this cat. He notes that the cat's main food consists of members of the 'Giberrellinae' [? Gerbillinae] and jerboas. *T. krepkogorski* has been recorded less frequently in canines. Sadikhov (1964) assigned worms from *Vulpes vulpes* in Azerbaijan to this species, and Agapova & Sapozhenkov (1961) record it from *V. vulpes karagan* in Turkmeniya. Verster suggests that the record given by Agapova & Sapozhenkov from *V. vulpes* may in fact refer to *T. endothoracica*, but as these authors give no description of their material Miss Verster presumably draws this conclusion solely from the fact that the host is a canine. However, the partial description given by Sadikhov of material from *V. vulpes*, in which the number of hooks is given as 60-64, suggests that this record, at least, may refer to *T. endothoracica*. *T. krepkogorski* therefore appears to have a preference for felines as definitive hosts and to occur solely in gerbils in its strobilocercus stage, being restricted in distribution to the desert areas of southwestern central Asia.

T. endothoracica has so far been recorded naturally as an adult only in *Vulpes vulpes* in Kazakhstan and the Caucasus by Dubnitski (1952). Gvozdev & Agapova (1963) have studied the experimental life-history of this species and have gained positive results in *V. vulpes*, *V. corsac* and the dog. I have not been able to discover any references to this species occurring in carnivores other than canines. The larva has been described a number of times. It is polycephalic and has been found in many species of gerbils in southwestern Asia and north Africa (Gvozdev & Agapova, 1963; Dollfus, 1956 and 1965). This species differs from *T. krepkogorski*, therefore, in its preference for canine definitive hosts and in the form of its larval stage.

Cysticercus macrocystis was originally described by Diesing (1850) as a larval form in *Lepus brasiliensis* [= *Sylvilagus brasiliensis*] in Brazil. The adult was first described by Lühe (1910) as *Taenia macrocystis* from various cats in Brazil and Paraguay, and since then the worm has been recorded a number of times from felids in North and South America (see Table 2). The larval stage, a strobilocercus, has been found in lagomorphs in North and South America (Lühe, 1910; Hall, 1919; Grundmann, 1958; Verster, 1969; Bursey & Burt, 1970). This species was first recorded in Russia by Petrov & Potekhina (1953) from *Vulpes vulpes* in Tadzhikistan, and the larval stage has since been recorded from hares, squirrels and gerbils in central Asia (Gubanov, 1956 and 1958; Gubanov & Fedorov, 1956; Kontrimavichus, 1959; Davlatov, 1967). Davlatov mentions the discovery of this species in a fox in Uzbekistan, and, as has already been stated, Gubanov (1956) successfully infected a wolf cub with material originating from a hare. In Russia this parasite has only once been recorded in a cat, that was in a lynx in Belorussia by Shimalov (1963). Both Gubanov and Davlatov have described the larva of this cestode. Gubanov (1956) calls the larva a cysticercus and makes it clear from his description that the scoleces are invaginated in the larval cyst. Davlatov (1967) states that the larva is a bladder-shaped helminth containing three capsules and twelve specimens. Neither description appears to refer to a strobilocercus-type larva, and it would seem that Davlatov's description is particularly ambiguous and could fit either a polycephalic or a coenurus larva, which according to Mahon (1954) may be related larval forms and quite distinct from a strobilocercus. Therefore the Russian form of *T. macrocystis* appears to differ from *T. krepkogorski* in larval type and in its host preference in both larval and adult stages.

The above statement also applies when comparing the Russian and the American forms of *T. macrocystis*. In Russia the adult shows an inclination to infest canines, a condition which has not been demonstrated in America, neither has the larva been found in rodents in America as it has, in a number of cases, in Russia. These facts indicate that these two forms may not be conspecific, and also suggest that a closer comparison with *T. endothoracica*, with its polycephalic larva and preference for canine hosts is very desirable.

To sum up, from the evidence presented above it appears that *Taenia krepkogorski* is a distinct species, occurring primarily in cats in southwestern central Asia, and is probably restricted in its larval (strobilocercus) form to gerbils. Moreover, it can be seen from the description that *T. krepkogorski* should be placed in Group II of Verster's classification of *Taenia* as the genital ducts pass ventrally to both excretory

TABLE 2

Records of adult *T. krepkogorski*, *T. macrocystis* and *T. endothoracica* in
Felidae and Canidae

Species	Felidae	Canidae	Reference
<i>T. krepkogorski</i>	<i>Felis libyca caudata</i> , Tadzhikistan	.	Petrov & Potekhina, 1951
	<i>Felis libyca ocreata</i> , <i>Felis margarita</i> , Turkmeniya	<i>Vulpes vulpes</i> , Azerbaijan	Sadikhov, 1954
	<i>F. margarita</i> , Turkmeniya	<i>V. vulpes karagan</i> , Turkmeniya	Agapova & Sapozhenkov, 1961
	<i>Felis chaus</i> , <i>Felis silvestris</i> , Azerbaijan		Sapozhenkov, 1961 Sadikhov, 1962a
	<i>F. margarita</i> , Bahrain		Present Study
<i>T. macrocystis</i>	<i>Felis wiedii</i> , <i>Felis yagouaroundi</i> , <i>Galictis</i> sp., <i>Felis</i> sp., Brazil, Paraguay		Lühe, 1910
	<i>Lynx rufus</i> , <i>L. rufus baileyi</i> , U.S.A.		Hall, 1919
	<i>Felis (Oncoides) macroura</i> , Brazil		Baer, 1927
	bobcat-lynx, Wyoming		Riser, 1956
	<i>L. rufus pallescens</i> , Utah		Grundmann, 1958
	<i>L. rufus</i> , Colorado		Leiby, 1961
	<i>L. rufus</i> , N. and S. Carolina		Miller & Harkema, 1968
	<i>L. rufus</i> , Texas		Little & Hopkins, 1969
	<i>F. wiedii wiedii</i> , Brazil		Verster, 1969
	<i>Lynx canadensis</i> , Alaska		
	<i>L. rufus</i> , New Brunswick		Bursey & Burt, 1970
	<i>L. canadensis</i> , Newfoundland	wolf-cub, exp. (Yakutsk)	Gubanov, 1956
		<i>V. vulpes</i> , Tadzhikistan	Petrov & Potekhina, 1953
	lynx, Belorussiya		Shimalov, 1963
<i>T. endothoracica</i>		<i>V. vulpes</i> , Kazakhstan and Caucasus	Dubnitski, 1952
		<i>V. vulpes</i> , <i>V. corsac</i> and dog, all exp. (U.S.S.R.)	Gvozdev & Agapova, 1963

vessels. In addition a comment is made concerning those specimens of *T. macrocystis* recorded in Russia which, it is suggested, may not be conspecific with the worm as it is known in the Americas, and may be comparable with *T. endothoracica*.

ACKNOWLEDGMENTS

I wish to express my thanks to Mr S. Prudhoe for his critical appraisal of this work and for encouragement and advice during the study, and to Mr D. W. Cooper for the preparation of the excellent serial sections. In addition I am greatly indebted to

Mrs H. Sabo and the late Dr S. Markowski for translations of the Russian literature and to Dr D. I. Gibson, Mr D. Claugher and the Electron Microscope Unit of the British Museum (Natural History) for the preparation of the photo- and electron micrographs.

REFERENCES

- AGAPOVA, A. I. & SAPOZHENKOV, Y. F. 1961. [The helminth fauna of wild carnivores of Turkmen SSR.] in: [Natural nidity of diseases and problems of parasitology, Alma-Ata] **3** : 288-290. [In Russian.]
- BAER, J. G. 1927. Die Cestoden der Säugetiere Brasiliens. *Abh. senckenb. naturforsch. Ges.* **40** : 377-386.
- BULIGINSKAYA, M. A., VLADIMIROV, V. L. & MARKOV, G. S. 1956. [The helminth fauna of *Rhombomys opimus* Licht. in Uzbekistan.] *Vest. leningr. gos. Univ.* **9** (2) : 62-72. [In Russian.] [*Helminth. Abstr.* **28** : 400.]
- , — & — 1959. [Helminths of *Rhombomys* and *Meriones* in Uzbekistan, with the description of a new genus of filariids, and the seasonal and age changes in the composition of parasites of *Rhombomys opimus*.] *Trudy gel'mint. Lab.* **9** : 54-58. [In Russian.]
- BURSEY, C. C. & BURT, M. D. B. 1970. *Taenia macrocystis* (Diesing, 1850), its occurrence in Eastern Canada and Maine, U.S.A., and its life cycle in wild felines (*Lynx rufus* and *L. canadensis*) and hares (*Lepus americanus*). *Can. J. Zool.* **48** : 1287-1293.
- DAVLATOV, N. 1967. [Great gerbil—new intermediate host of *Taenia macrocystis*.] *Dokl. Akad. Nauk uzbek. SSR* **9** : 51-52. [In Russian.]
- DOLLFUS, R. P. 1956. Un hôte nouveau pour le cystique polycéphale de *Taenia* (*Multiceps*) *endothoracicus* Ja. D. Kirschenblatt, 1948. *Bull. Soc. Path. exot.* **49** : 281-284.
- 1965. Cestodes de carnivores, rongeurs, insectivores, reptiles et batraciens. *Annls Parasit. hum. comp.* **40** : 61-86.
- DUBNITSKI, A. A. 1952. [Data on the life-cycle of the cestode *Multiceps endothoracicus* Kirschenblatt, 1947.] *Dokl. Akad. Nauk SSSR* **85** : 1193-1195. [In Russian.]
- GRUNDMANN, A. W. 1958. Cestodes of mammals from the Great Salt Lake desert region of Utah. *J. Parasit.* **44** : 425-429.
- GUBANOV, N. M. 1956. [On the biology of *Taenia macrocystis* (Diesing, 1850).] *Uchen. Zap. mosk. gos. pedagog. V. I. Lenina* **96** : 151-154. [In Russian.]
- 1958. [Infestation of rodents in Yakutiya by larval cestodes.] *Nauchn. Soobshch. Yakutsk Fil. Sibirsk. Otdel. Akad. Nauk SSSR* (**1**) : 109-114. [In Russian.] [n.v.]
- GUBANOV, N. M. & FEDOROV, K. P. 1956. [Helminths and helminthiasis of mountain hares (*Lepus timidus*) in Verkhoyansk.] *Uchen. Zap. mosk. gos. pedagog. V. I. Lenina* **96** : 127-135. [In Russian.] [*Helminth. Abstr.* **25** : 336.]
- GVOZDEV, E. V. & AGAPOVA, A. L. 1963. [Life-cycle of *Multiceps endothoracicus* Kirschenblatt, 1948.] *Trudy Inst. Zool., Alma-Ata* **19** : 72-82. [In Russian.]
- HALL, M. C. 1919. The adult taenoid cestodes of dogs and cats, and of related carnivores in North America. *Proc. U.S. natn. Mus.* **55** : 1-94.
- KONTRIMAVICHUS, V. L. 1959. [Helminths of hares in the U.S.S.R., and the zoogeographical analysis.] *Trudy gel'mint. Lab.* **9** : 133-144. [In Russian.]
- LEIBY, P. D. 1961. Intestinal helminths of some Colorado mammals. *J. Parasit.* **47** : 311.
- LITTLE, J. W. & HOPKINS, S. H. 1969. New locality records for *Taenia rileyi* Loewen, 1929, and *Taenia macrocystis* Diesing, 1850, and a comparison of some hook measurements. *Proc. helminth. Soc. Wash.* **36** : 268-269.
- LÜHE, M. 1910. Cystotänien südamerikanischer Feliden. *Zool. Jb. Suppl.* **12** : 687-710.
- MAHON, J. 1954. Tapeworms from the Belgian Congo. *Annls Mus. r. Congo belge Sér.* **5** **1** : 137-264.
- MILLER, G. C. & HARKEMA, R. 1968. Helminths of some wild mammals in the south-eastern United States. *Proc. helminth. Soc. Wash.* **35** : 118-125.

- PETROV, A. M. & POTEKHINA, L. F. 1951. [The life cycle of the cestode *Hydatigera krepkogorski* Schulz and Landa, 1934.] *Dokl. Akad. Nauk SSSR* **76** : 163-164. [In Russian.]
- & — 1953. [The helminth fauna of predacious mammals in Tadzhikistan.] *Trudy vses Inst. Gel'mint.* **5** : 82-94. [In Russian.] [*Helminth. Abstr.* **22** : 365.]
- RISER, N. W. 1956. The hooks of taenioid cestodes from North American felids. *Am. Midl. Nat.* **56** : 133-137.
- SADIKHOV, I. A. 1954. [Contribution to the study of helminths from the Azerbaijan fox.] *Dokl. Akad. Nauk azerb. SSR* **10** : 127-129. [In Russian.]
- 1962a. [On the helminth fauna of wild Felidae in Azerbaijan.] *Izv. Akad. Nauk azerb. SSR [Ser. biol. med.]* (2) : 59-61. [In Azerbaijani.]
- 1962b. [Helminth fauna of the fur animals of Azerbaijan.] [Animal World of Azerbaijan, Baku] **4** : 1-174. [In Azerbaijani.]
- SAPOZHENKOV, Y. F. 1961. On the distribution and ecology of *Felis margarita* in East Turkmenia. *Zool. Zh.* **40** : 1086-1089. [In Russian; English summary.]
- SCHULZ, R. E. & LANDA, D. M. 1934. [Parasitic worms of the great gerbil—(*Rhombomys opimus* Licht.).] *Vest. Microbiol. Épidem. Parazit.* **13** : 305-315. [In Russian; German summary.]
- SHIMALOV, V. T. 1963. [Cestoda of predatory mammals of Belorussiya.] *Dokl. Akad. Nauk belorussk. SSR* **7** : 638-641. [In Russian.]
- SHLEIKHER, E. I. & SAMSONOVA, A. V. 1953. Helminthofauna of the great gerbil of Uzbekistan. Contributions to Helminthology, published to commemorate the 75th birthday of K. I. Skrjabin. Izdat. Akad. Nauk SSSR, Moscow. [English translation: Israel program for scientific translations, Jerusalem, 1966 : 770-773.]
- SULTANOV, M. A., MUMINOV, P. & ADYSHEVA, M. M. 1962. [Helminths of wild animals of Golodnoi Steppe.] *Zhivot. Mir Golodnoi Steppe* : 25-30. [In Russian.] [n.v.]
- VERSTER, A. 1969. A taxonomic revision of the genus *Taenia* Linnaeus, 1758, s. str. *On-derstepoort J. vet. Res.* **36** : 3-58.

PLATE 1

Taenia krephogorski: views of scolex showing arrangement of the rostellar hooks.

- a. light microscope *en face* view.
- b. stereoscan microscope *en face* view.
- c. stereoscan microscope side view.

